Cell and Developmental Biology Interest Group

Syracuse, New York

Amack Lab

PI: Jeffrey D. Amack, PhD
Department: Cell and Developmental Biology
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Research Interests: We are interested in understanding mechanisms that control morphogenesis of cells, tissues, and organs during embryonic development. In one project, we are investigating cell behaviors and tissue interactions underlying the development of a ciliated 'left-right organizer' that specifies the left-right body axis in vertebrates. We are focused on both molecular mechanisms and mechanical mechanisms. In another project, we are investigating functions for the vacuolar-type H^+-ATPase (V-ATPase) H^+ pump during embryonic development. We are specifically testing functions for pH regulation in cilia development and hair cell survival. We primarily use the zebrafish as a model vertebrate embryo.

Technical Expertise:

- Zebrafish genetics and embryology
- Microinjection of zebrafish embryos
- CRISPR in zebrafish
- Confocal microscopy
- 4D imaging of living embryos
- Whole-embryo RNA in situ hybridization
- Whole-embryo fluorescent immunostaining
- FACS-RNAseq
- Transmission electron microscopy

Key Words: Embryonic development; genetics; mechanobiology; cilia; left-right asymmetry; ion flux; zebrafish.

Lewis Lab

PI: Kate Lewis, PhD
Department: Biology
Institution: Syracuse University
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Research Interests: Most of the research in our lab focuses on understanding how spinal cord interneurons acquire their specific functional characteristics during development. Currently, we are focusing mainly on how the neurotransmitter phenotypes of these neurons are specified. We concentrate mostly on genetics and uncovering and investigating gene regulatory networks, although we also investigate the molecular mechanisms through which genes we are interested in act. We

primarily use zebrafish embryos as a model system. We also use zebrafish to examine the toxicity of environmental contaminants and compounds used to decontaminate polluted water, and we test whether exposure to these chemicals increases the incidence of convulsive seizures or epilepsy.

Technical Expertise (as of October 2019 – may change as personnel change):

- Zebrafish genetics and embryology
- Microinjection of zebrafish embryos
- CRISPR in zebrafish (indels and transgenic knock-ins)
- FACS-RNAseq and FACS-qPCR (for example, we have a good protocol for RNA extraction following FACs that we are happy to share
- Whole-embryo RNA in situ hybridization
- Tol2 transgenesis
- KASP and high resolution melt-analysis genotyping
- Gibson assembly and gateway cloning
- Co-immunoprecipitation and western blotting
- Zebrafish sperm cryopreservation and IVF
- We have recently done some single cell seq
- We have previously done a yeast 2 hybrid screen
- Whole-embryo fluorescent immunostaining
- We have a set up for simultaneous detection of two fluorescent wavelengths on a compound microscope (for calcium indicator experiments etc)
- We have a Diagenode Bioruptor Plus sonicator (for shearing DNA and chromatin for ChIP-seq experiments)

Key Words: Embryonic development; genetics; neural development; neurotransmitter, spinal cord interneuron, toxicology studies; zebrafish embryo PTZ seizure model; zebrafish.

Ma Lab

PI: Zhen Ma, PhD
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Research Interests: I have a broad background in engineering with multidisciplinary training in stem cell biology, micro/nanotechnology and cardiovascular physiology. My lab focuses on the cardiac mechanobiology at different scales based on human iPSC technology, including (i) developmental mechanobiology based on the cardiac organoid model, focusing on the mechanisms of biophysical-driven multicellular self-organization and cardiac tissue patterning; (ii) tissue mechanobiology based on the 3D cardiac microtissues, focusing on the relationship between tissue biomechanics and cardiomyopathy disease progression; and (iii) single cardiomyocyte mechanobiology based on stimuli-responsive biomaterials, focusing on dynamic reorganization of myofibrils and sarcomeres of hiPSC-cardiomyocytes in response to the programmable extracellular mechano-structural cues.

Technical Expertise:

- Microfabrication and cell micropatterning
- Cardiac contractile motion analysis

- Human induced pluripotent stem cells culture and differentiation
- Mesenchymal stem cells
- Confocal Microscopy

Key Words: Stem cells; Mechanobiology; Cardiac tissue engineering; Biomaterial fabrication

Pruyne Lab

PI: David W. Pruyne, PhD
Department: Cell and Developmental Biology
Institution: SUNY Upstate Medical University
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Research Interests: Our interest is to learn how cell's organize their cytoskeleton, with the goal of understanding how interactions between proteins at the biochemical level scale up to the assembly of the spatially and compositionally distinct cytoskeletal substructures that co-exist within a cell. We have been particularly focused on cytoskeleton-organizing proteins called Formins, and in teasing out their roles in the development of striated muscles, using the simple nematode *Caenorhabditis elegans* as a model system.

Technical Expertise:

- *C. elegans* genetics and development
- Microinjection and microparticle bombardment of *C. elegans* for transformation
- RNAi in *C. elegans*
- Scanning confocal microscopy of live and fixed *C. elegans* larvae and adults
- DIC microscopy of live *C. elegans* adults and embryos
- Immunostain of intact and dissected *C. elegans*, particularly larvae and adults
- Expression and purification of recombinant proteins from *E. coli*
- Protein purification from *C. elegans*
- Pyrene-actin-based *in vitro* actin filament assembly assays
- Phylogenetic analysis of protein families

Key Words: *C. elegans*; cytoskeleton; formin; actin; muscle development.

Zuber Lab

PI: Michael E. Zuber, PhD
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Research Interests: We are interested in identifying and understanding the cellular and molecular mechanisms required for normal eye formation. Normal nervous system development requires the

precise control of both cell proliferation and differentiation (neurogenesis). Diseases resulting in too few, the wrong type, or too many neural cells, all have devastating effects, including developmental defects, cancers, and abnormal eye and brain function. Our lab uses both frogs and mice to address the fundamental question, “How are proliferation and differentiation properly balanced in neural cells?” Our long-term goals are to determine how this balance is maintained and identify changes that disrupt normal neural differentiation. Answering this seemingly simple question could lead to treatments for human diseases resulting from premature or delayed neurogenesis in the developing eye and brain.

Technical Expertise:

- Whole-embryo & section RNA *in situ* hybridization
- Whole-embryo & section fluorescent immunostaining
- Design and use of activator and repressor versions of transcription factors
- Expression & functional modulation of gene activity during *X. laevis* development by RNA microinjection
- Inhibition of target protein synthesis using translation & splice blocking Morpholino antisense oligonucleotides.
- Transgenic and CRISPR-based gene modification in *X. laevis*
- DNA & protein phylogenetic analysis.
- Ablation, isolation, recombination & transplantation of cells and tissues between modified (e.g. transgenic, knockout, morpholino knockdown, overexpressing) and wild-type animals.
- Recombination and transplantation experiments make it possible to study cell fate, tissue interactions and the self-organization capacity of cells, tissue and organs in a developing vertebrate embryo.
- Ablation and isolation experiments provide evidence that a given gene or tissue is necessary (ablation) and/or sufficient (isolation) for the normal development of an organ – again, in a living developing animal.
- Tissue determination using animal cap transplant assays in *X. laevis*.
- Inducible and reversible celltype specific ablation in living animals.

Key Words: neurogenesis; embryonic neural development; retinal development; regeneration; gene (transcription factor) networks; cell cycle regulation; ubiquitin-proteasome system; ubiquitin conjugating enzyme.